



The Anti-Terrorist Force Protection Program allows the military to rehearse defensive tactics from a first-person point-of-view...

The guided missile destroyer was visiting a foreign port. The captain, a highly decorated, battle-hardened veteran, scrupulously followed Navy regulations, setting up a defensive perimeter of crewmen in motorized launches that patrolled the area 24 hours a day. Without warning, a speedboat raced toward the Naval vessel. The launches moved to intercept but were no match for the smaller craft, which was loaded with explosives. It zipped past the defenders and rammed the destroyer.

Had this been an actual attack, it would have cost the lives of countless American crewmen and inflicted millions of dollars in damage to the ship. In simulation, however, such disasters can be reversed — a luxury not afforded to ship commanders in the field. Through repeated rehearsals, a captain can adjust his defensive strategy and intercept virtual attackers before they reach their targets.

The Anti-Terrorism Force Protection Program is a 3-D simulation project developed by Dr. Don Brutzman and the SAVAGE Group (Scenario Authoring and Visualization for Advanced Graphical Environments) at the MOVES Institute (Modeling, Virtual Environments and Simulation), located at the Naval Postgraduate School in Monterey, Calif.

In this X3D XML (Extensible Markup Language) and agent-based simulation, named “the USS Cole Scenario,” after a Navy ship that was attacked and damaged in the manner described above, users can rehearse various terrorist attacks with a first-person point-of-view.

“You can realistically assess defensive tactics and see what would or would not protect the ship from attack,” Brutzman said. “You can replay dangerous ‘what-if’ scenarios and the risks are virtual.”

Virtual Worlds for Smart Submarines

“We started creating virtual environments because that was the only way to test-program Autonomous Underwater Vehicles (AUVs),” Brutzman explained. “Once an AUV is launched, it’s on its own. If there is a flaw in the programming, there’s no predicting

what it might do. It is tremendously difficult to observe, communicate with and test underwater robots because they operate in a remote and hazardous environment.”

To that end, Brutzman’s team needed to create a realistic underwater virtual world that could comprehensively model all salient functional characteristics of the real world in real-time. This virtual world was designed from the perspective of the robot, enabling realistic AUV evaluation and testing in the laboratory. “Robots don’t need imaging to navigate; people need imaging to understand the robot’s logic,” said Jeff Weekley, a senior designer with the MOVES Institute. “3-D, real-time graphics are our window into the virtual world.”

Visualization of robot interactions within a virtual world allows sophisticated analyses of a robot’s performance. Sonar visualization permits researchers to look over the robot’s shoulder or even see through its eyes to understand sensor-environment interactions intuitively. “This is not a video game,” Brutzman stressed, “but a real-world simulation. It not only has to look real ... it has to be real.” He added, “We need to model the real world in as much detail as possible.” This is vital, as the Navy wants to be sure the AUVs tested in simulation at the MOVES Institute will behave the same way in the open ocean.

NPS AUV Workbench

As a result of this research, the NPS AUV Workbench is now publicly available. A poster and self-installer can be found at <http://terra.cs.nps.navy.mil/AUV/workbench>.

The poster states, “The NPS AUV Workbench supports physics-based AUV modeling and visualization of vehicle behavior and sensors in all mission phases. Animation is based on vehicle-specific hydrodynamics that can be configured to model arbitrary vehicles. Models defined in X3D and VRML (*pronounced ver-mal, Virtual Reality Modeling Language, 3-D equivalent of HTML*) relying on IEEE Distributed Interactive Simulation Protocol (DIS) allow visualization across networks utilizing custom software or off-the-shelf Web browsers.

Virtual environments facilitate control algorithm development, constant testing, mission generation and rehearsal and replay of completed missions in a benign laboratory environment.

Building a Virtual World Viewer

The benefits don’t stop there, though. “Once you develop tools for creating virtual environments,” Brutzman said, “the applications are almost limitless.” A good graphics toolkit for building a virtual world viewer has many requirements to fill. Rendered scenes need to be realistic and rapidly rendered, permitting user interaction. The tools need to be capable of running on both low-end and high-end workstations. Graphics programmers must have a wide range of tools to permit interactive experimentation and scientific visualization of real-world data sets.

The ability to read multiple data formats is also important when using scientific and oceanographic data sets. Scientific data format compatibility can be provided by a number of data function libraries that are open, portable, reasonably standardized and

usually independent of graphics tools. Viewer programs need to be capable of examining high-bandwidth information streams and large archived scientific databases.

The ability to pre-process massive data sets into useful, storable, retrievable graphics objects will be particularly important as we attempt to scale up to meet the sophistication and detail of the real world. Standardization of computer graphics and portability across other platforms, Brutzman pointed out, is also desirable but historically elusive. Simulation software should be able to take advantage of the Internet and run virtual environments remotely, according to Brutzman. "History has taught us that virtual worlds often outlast the proprietary hardware and software they were designed on." To achieve these goals, the MOVES Institute has been involved in development of several open standards. These include XMSF and X3D.

XMSF

The Extensible Modeling and Simulation Framework (XMSF) is a set of Web-based technologies, applied within an extensible framework, enabling a new generation of modeling and simulation (M&S) applications to emerge, develop and interoperate. Specific subject areas for XMSF include: (a) Web/XML, (b) Internet/networking and (c) modeling and simulation (M&S). XMSF information can be found at <http://www.movesinstitute.org/xmsf/xmsf.html>. XM-based Web services are sufficiently powerful for all types of modeling and simulation.

X3D

Extensible 3D (X3D) is the ISO-approved next-generation open standard for 3-D on the Web. It is an extensible standard that can easily be supported by content creation tools, proprietary browsers and other 3-D applications, both for importing and exporting. X3D not only replaces VRML but also provides compatibility with existing VRML content and browsers. Existing VRML content will be played without modification in any X3D-2 browser, and new X3D-1 and X3D-2 content can be read into existing VRML applications.

X3D addresses the limitations of VRML. It is fully specified, so content will be fully compatible. It is also extensible, which means that X3D can be used to make a small, efficient 3D animation player or to support the latest streaming or rendering extensions. It supports multiple encodings and APIs (application program interfaces), so it can easily be integrated with Web browsers through XML or with other applications. In addition to close ties with XML, X3D is the technology behind MPEG-4's 3-D support. X3D information can be found at www.web3d.org.

Don Brutzman is right. With the proper tools for creating virtual environments, the applications truly are nearly limitless.

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CHIPS



Background

The small computer system interface (SCSI) standard, commonly referred to as "scuzzy," is continually evolving. To keep you informed of the latest SCSI changes, we teamed up to provide a follow-up to a SCSI article which appeared in the *CHIPS Summer 2004* edition (http://www.chips.navy.mil/archives/04_summer/Web_Pages/scuzzy.htm). This article, Part I, of a two part series, will highlight the latest SCSI technologies and standards. For example, there are new devices available such as the Ultra SPI-3 (SCSI-3 Parallel Interface) and SPI-4, and Ultra160 or Ultra320 parallel SCSI devices. The Ultra160 doubles Ultra2 SCSI's speed by as much as 160 MBps for a 16-bit data bus. It is commonly referred to as the Fast-80.

The Ultra160 uses a SPI-3 third generation parallel SCSI interface, which adds five new features: (1) Fast-80 or a data bus speed running at 80 MHz; (2) Cyclic Redundancy Check (CRC) - a common error checking protocol, which is used to ensure data integrity as a safety measure since transfer speeds were being increased, leading to the possibility of data corruption; (3) Domain Validation, which improves the robustness of the process by which different SCSI devices determine an optimal data transfer rate; (4) Quick arbitration and selection (QAS), which represents a change in the way devices determine which device has control of the SCSI bus. (This feature provides a small improvement in performance.); and (5) Packetization - reduces the overhead associated with data transfer.

The Ultra320 uses SPI-4 fourth generation interface for SCSI and has similar features of the SPI-3 except that it again doubles the speed of data transfer to 320 MBps by running the data bus speed at 160 MHz. The Ultra320 is also referred to as Fast-160.

What's New?

Early in 2003, Ultra640 was issued as a standard by the International Committee for Information Technology Standards (INCITS) and called 367-2003 or SPI-5. The SPI-5 is the fifth generation of the SCSI-3 standard. SPI-5 incorporates Fast-320. Ultra640 required a new transfer mode with a 160 MHz free running clock speed to eliminate Inter-Symbol Interface (ISI) problems. Ultra640 uses paced data transfers or packetized SCSI; a free running clock; ISI pre-compensation drivers and active adapter filter receivers; skew compensation; training patterns for the adaptive active filters; and expander communications.